must be first-class graduates of leading technical schools. We start them on trial at 8*d.* an hour, and if really bright they may be earning 30*l.* a month with us at the end of eight months. We are always on the look-out for bright men; we cooperate with the professors of colleges to get them." "Two of the chiefs of the staff of the Westinghouse Company," says Prof. Ayrton later, "visit all the principal universities, colleges, and technical schools throughout the United States every year for the purpose of seeing the students, and choosing those who are most suitable to work with the Westinghouse Company." College students, too, are encouraged to work in the shops during vacation time, and in this way to supplement theoretical knowledge with practical experience.

Still another way in which the connection between the training given in the technical schools and colleges and the needs of industry is in America made intimate and real is to be found in the conditions of tenure pertaining to professorships. All the practical men engaged in engineering consulted by Prof. Ayrton were unanimous in telling him that "an engineering professor in a college should be actively engaged in the practice of his profession." Or, as he says later in his report, "engineering education in America is directed by those who are doing the engineering work of their country." Prof. Maclean's evidence is in the same direction; he states, "superior men are induced to accept collegiate appointments because of the well-equipped laboratories at their disposal, and because as engineering professors they are given every opportunity and encouragement to do outside work. It is believed that thus they keep in touch with the various lines of progress in their profession." Prof. Ripper, too, adds his testimony to the same effect. He writes, "it is considered vital that the professor should be in the field of practice, otherwise he is liable to become stale and out of date, and to attach exaggerated importance to unnecessary things."

The scepticism of the British manufacturer as to the value of a scientific training in the workshop and factory, his neglect of the technical expert, and his ingrained conservatism are already painfully familiar to men of science. It is unnecessary to insist, in view of what this latest report tells of American enlightenment, that in the absence of an earnest endeavour by British directors of industry to follow the lead of their contemporaries in the States, the results will be disastrous—indeed, fatal—to our commercial supremacy.

To turn now to the extent that science is in America utilised in the service of the State—a matter the importance of which has been urged consistently in these pages. A joint report, signed by the commissioners as a body, places it on record that "the closest connection is being established between theory and practice, the practical bent of the men of letters and science and the breadth of their outlook being very remarkable. The services of experts in various branches of knowledge are, therefore, held in high esteem and are in constant demand." And Prof. Armstrong, in a report brimful of good things, gives numerous examples of the appreciation by the American Government of the services of men of science. To quote one or two of his *obiter dicta*:—"So far as I am aware, there is nothing anywhere to compare with the way in which science is being utilised in the service of the State by the U.S. Department of Agriculture." "There is no question that the research work done under the auspices of the Agricultural Department and in the experiment stations is of the very greatest value, and is contributing most materially to the development of agricultural industry." "One branch of work initiated in the Office of Experiment Stations at Washington of extreme importance, to which reference should also be made, is that relating to the nutrition of man, which has been carried out in various parts of the States under the supervision of my friend Prof. Atwater." If it were necessary, similar examples from these reports could be multiplied a hundredfold.

In a short review it is possible only to touch the fringe of so great a subject. Much of value in the reports has been left completely on one side. But it is greatly to be desired that every man of science, every person engaged in education, whether as administrator or teacher, will study the volume. It is an important and absorbingly interesting contribution to a subject that deserves the immediate attention of every one of our statesmen.

A. T. S.

NOTES.

THE annual conversazione of the Royal Society will be held on Friday, May 13.

WE regret to see the announcement of the death of Prof. E. Duclaux, director of the Pasteur Institute, at sixty-three years of age.

PROF. A. W. WILLIAMSON, F.R.S., is lying dangerously ill at his residence at Haslemere.

INVITATIONS have been issued by the Royal Society of Edinburgh to a conversazione to be held in the rooms of the society on Saturday, May 28.

PROF. HENRI BECQUEREL, of Paris, has been elected a corresponding member of the Berlin Academy of Sciences.

THE deaths are announced of Prof. Leidie (chemistry), of Paris, and Prof. Charles Soret (experimental physics), of Geneva.

IN the *Physikalische Zeitschrift* for April 15, Prof. Th. Indrikson states that he has repeated Sir William Ramsay's experiments showing the spectrum of helium in the emanations from radium, the experiments being in this case conducted in the physical institute at St. Petersburg, where no experiments with helium had previously been made.

IT is announced that an annual subsidy of 35,000 kr. (1950*l.*) for twenty years has been granted by the Icelandic Government for the establishment of a wireless telegraphic connection between Iceland and the Shetland Islands or the mainland of the United Kingdom, and also between the four principal towns of Iceland.

THE council of the Institution of Civil Engineers has made the following awards for papers read and discussed before the institution during the past session:—A Telford gold medal to Major Sir Robert Hanbury Brown, K.C.M.G., a George Stephenson gold medal to Mr. G. H. Stephens, C.M.G., and a Watt gold medal to Mr. Alphonse Steiger. Telford premiums to Mr. E. W. de Rusett, Dr. Hugh Robert Mill, Mr. Alexander Millar, and Dr. T. E. Stanton. A Manby premium to Prof. J. Campbell Brown, and a Crampton prize to Mr. L. H. Savile. The presentation of these awards, together with those for papers which have not been subject to discussion and will be announced later, will take place at the inaugural meeting of next session.

THE Geologists' Association has arranged an excursion to Derbyshire for Whitsuntide. Four days are to be devoted to out-door geology. The party leaves St. Pancras for Buxton on Friday, May 20, and is expected to arrive in London from Derby on Wednesday, May 25. On Saturday, May 21, the excursion will be directed by Messrs. H. A.

Bemrose, E. Sandeman, and H. Lapworth, but for the other three days Mr. Bemrose alone will be the director. The details of the excursion seem to have been carefully planned, and full particulars of these, together with information as to special fares and hotel arrangements, can be obtained from the excursion secretary, Mr. H. Kidner, 8 Derby Road, Watford.

A CIRCULAR on the present state of the trade in indigo between India and Aleppo, prepared by the reporter on economic products to the Government of India, is noted in the *Journal* of the Society of Arts. It appears that between 600 and 700 chests of indigo are imported into Aleppo from India every year. On account, however, of the competition of German synthetic indigo, this is usually sold by the merchants at a loss. This synthetic indigo has two advantages over the natural product, viz. that it is cheaper and that its price does not vary. The native dyers have found that when natural and synthetic indigo are mixed in about equal proportions, the resulting mixture is more durable and also brighter in colour than the natural indigo. On account of the impetus that has been given to the dyeing industry by the popularity of this mixed dye, much more indigo is used than formerly, and the reduction in the demand for natural indigo has not been nearly so great as might have been expected from the introduction of synthetic indigo.

WE have received a copy of the results of the magnetical and meteorological observations made at the Royal Alfred Observatory, Mauritius, in the year 1900, and we note a marked improvement in the form in which the results are now presented, being on the pattern of the Greenwich observations. The routine work has been carried out in a very satisfactory and thorough manner. Photographs of the sun are taken daily, when possible, and the negatives sent to the Solar Physics Committee in London. Meteorological bulletins are supplied daily to the local Press, and copies of monthly results are forwarded to this country and elsewhere. Rainfall observations are now made at about seventy stations, and the results are duly tabulated. Special attention is also given to magnetical and seismological observations.

MR. J. R. SUTTON has contributed to the report of the South African Association for the Advancement of Science a valuable paper containing the determination of mean results from meteorological observations made at second order stations on the table land of South Africa. Observations in Cape Colony are generally made at 8h. a.m. (mean time of the colony), but at some stations other hours are used. The object of the paper is to give materials for reducing these to a common standard of reference. At the cost of a great amount of labour, the author has calculated, from the very complete observations made at Kimberley, the corrections to be applied to means for each hour for all elements in order to obtain the true mean for each month and for the year. He makes suitable reference to the work of the late Mr. Stone, who made a somewhat similar calculation from the Cape observations for 1841–6.

DR. T. LEVI CIVITA contributes a note to the *Atti dei Lincei* for March 20 on Kepler's equation $nt = u - e \sin u$, and the limits of convergency of the well known expansion of u in powers of e.

SOME experiments by Prof. A. Stefanini and Dr. L. Magri on the influence of radium on the electric spark, communicated to the *Atti dei Lincei*, xiii. (1), 6, by Prof. Battelli, lead to the following results:—For discharges between two spheres, or between a positively charged point or sphere and negative disc, the discharge is facilitated by radium for short sparking distances and impeded for longer ones; at these distances the radium influences the positive pole. If the disc is positive and the sphere or point negative, the discharge is impeded at small sparking distances within a limited interval; in general the effect is nil. For certain sparking distances between a sphere and disc it is possible for radium to impede or facilitate discharge according to which electrode is positive.

IN the April number of *Climate*, the anti-malarial campaign at Ismailia is described. Dr. Harford discusses sleeping sickness and its cause, and articles of medical interest, reviews and notes complete the contents of this useful journal.

IN a pamphlet entitled "Recent Improvements in Methods for the Bacterial Treatment of Sewage" (Sanitary Publishing Co.), Mr. Dibdin describes his multiple surface bacteria beds. The basis of his thesis is that there is no need for sewage to undergo a preliminary anaërobic treatment as in the case of the septic tank process, but that aërobic action alone suffices under the proper conditions. Mr. Dibdin constructs his beds of ridged tiles or of slate débris.

IN the *Bulletin* of the Johns Hopkins Hospital for February (vol. xv., No. 155), Dr. Kennon Dunham describes the effects of the Röntgen rays on lower animal life. These differed with the particular species exposed, Chilomonas and two species of Paramæcium being killed after six exposures, each of three minutes' duration on three successive days, while rotifers, Arcella and Cryptomonas were unaffected by this treatment. As regards the different rays, those having the strongest action were found to be directed from the centre of the anode plate in a line perpendicular to its face, and focused by passing through a cylinder of sheet lead. The most destructive rays were produced by a medium low tube excited by a heavy electrical discharge which had been passed across spark gaps or other resistance sufficient to produce rays of great penetrative power, such as will give a clear picture of a deeply seated bone, *e.g.* the hip, in three or four minutes. Dr. Leonard Hirshberg proves by a number of experiments that the species of anopheles mosquito (*A. punctipennis*) so abundant in and about Baltimore does not transmit malaria. There are also other excellent articles, but of purely medical interest.

MESSRS. HEPBURN and Waterston, in the April issue of the *Journal of Anatomy and Physiology*, continue their account of the histology of the motor-cells and accessory nerve in the spinal nerve-column of the porpoise. Another article in the same *Journal* contains the report of the second of a series of lectures by Prof. A. Robinson on the early development of the ovum and the differentiation of the placenta in various mammalian groups.

IN the April number of the *Zoologist* the editor, Mr. W. L. Distant, commences a series of articles on rivers as factors in the distribution of animals, dealing in this instance with their restrictive action. Many instances are noted where rivers form the boundary to the range of species or groups of mammals, a notable case being the limitation of the area of the viscacha by the Uruguay River, although the country to the north appears in every way as well suited to the habits of that rodent as are the pampas to the south.

THREE papers on vertebrates constitute the chief contents of the instalment of the *Proceedings* of the Philadelphia

Academy last to hand. In one Mr. J. A. G. Rehn continues his survey of the American bats, dealing in this instance with the genus Dermonotus (Pteronotus), a close ally of Chilonycteris, which, as already noticed in NATURE, formed the subject of his preceding article. Of the other two papers—both by Mr. H. W. Fowler—one is devoted to the description of berycoid fishes, and the second to certain fresh-water fishes from various parts of the United States.

THE presidential address to the Indiana Academy for 1902, which is only just to hand, in the *Proceedings* of that body, is devoted to a survey of the rise and progress of science in Indiana, which date practically from the conclusion of the war of secession. Special attention is devoted to the benefits conferred by science on agriculture, and it is pointed out that, as the result of these investigations, farmers in Indiana will eventually grow only such crops as are best suited to local conditions, and therefore the most remunerative.

THE second part of the first volume of *Records* of the Albany Museum contains five notes by Dr. R. Broom on South African anomodont reptiles. In one of these he discusses the affinities of the pavement-toothed genus Endothiodon, which was placed by Mr. Lydekker among the dicynodonts, but transferred by Prof. Seeley to the theriodonts. The new evidence demonstrates that the endothiodonts are so closely related to the dicynodonts that it is doubtful whether there is any cranial difference between the two groups, except the presence or absence of the palatal teeth.

AN excellent specimen of modern American zoological work is presented in a long and copiously illustrated article on the "Phylogeny of Fusus and its Allies," by Mr. A. W. Grabau, published in vol. xiv. of the *Smithsonian Miscellaneous Collections*. The shells of gastropods, when complete, are admirably adapted for phylogenetic study, since they display the whole growth—from the protoconch onwards—externally. The characters of the protoconch are found to be of prime importance in the group in question, although these must be correlated with the structure of the adult shell. One of the most important results of this line of investigation is the discovery that the genus Cyrtulus, represented by a single species from the Pacific, instead of being inseparable from the Eocene Clavilithes, forms a perfectly distinct type. The well known shells from the Barton Eocene commonly designated in geological works *Fusus longaevus* are shown to indicate at least three specific types of Clavilithes, one of which is regarded as new, under the title of *C. solanderi*.

THE periodic growth of scales as an index of age in the various members of the cod family forms the subject of a very important paper by Mr. J. S. Thomson in the first part of vol. vii. of the *Journal* of the Marine Biological Association. It has long been known that such growths are annual in the carp, and it is therefore probable that the same holds good for salt-water fishes. So far as can be determined by observation and experiment, this induction appears to be well founded in the case of the Gadidæ, and the author is of opinion that, after making all due allowance for individual variation, the age of these fishes can be determined by the number of rings (not the smaller lines) in their scales. Labelling of individual fishes returned to the sea, after their scales have been examined, would afford definite proof of the truth (or otherwise) of the theory. The paper is illustrated with a number of excellent plates.

THE March number of the *Quarterly Journal of Microscopical Science* contains an important paper on the dermal fin-rays (dermotrichia) of fishes, by Mr. E. S. Goodrich, of the Oxford Museum. Such structures may be divided into three types. In the sharks and chimæras these rays (ceratotrichia) are unjointed and composed of a fibrous hornlike substance devoid of bone-cells, and unconnected with the placoid scales found in the skin. In Teleostomi (bony fishes and ganoids), on the other hand, we find small unjointed, horny rays (actinotrichia) on the edges of the fins, which are probably remnants of the ceratotrichia, and, in addition, branched, bony lepidotrichia, developed externally to the actinotrichia, and in primitive forms closely resembling the body-scales. They are probably derivatives from scales which once clothed the fins. Finally, the lungfishes have jointed, bony rays (camptotrichia) containing bone-cells, and probably representing the lepidotrichia of the teleostomes. In the same issue the editor, Prof. E. Ray Lankester, re-publishes his "Encyclopædia" article on the Arthropoda, one reason for this being that it may readily come under the notice of foreign naturalists. Our readers may be reminded that the author considers the one great feature uniting chætopods, rotifers, and arthropods in a common group is the presence in each body-ring of a pair of hollow appendages—paropodia—moved by intrinsic muscles and penetrated by blood spaces.

ATTENTION was directed in NATURE (May 17, 1900) to an article by Mr. Lester F. Ward on the "Petrified Forest" of Arizona, and reference was then made to the presence of a petrified trunk which formed a "natural bridge" across a canyon. We have now received an article by Prof. Oscar C. S. Carter on "The Petrified Forests and Painted Desert of Arizona" (*Journ.* Franklin Inst., April), and this contains a number of illustrations of the scenery, including the natural (agate) bridge, which we are enabled to reproduce. The silicified trunks of trees are considered to be of Triassic age, and most of them are relics of the denudation of the strata; that represented in the natural bridge is, however, *in situ*. The "Painted Desert" is so named on account of the bright colours of the sandstones, shales, and clays—the rocks being eroded into fantastic shapes, and being coloured blue, yellow, red or green in places; hence the effect in sunlight is brilliant. An illustration is given of pictographs made by cliff dwellers on a face of sandstone near the petrified forest. The silicified tree trunks mostly belong to forms allied to the Norfolk Island pine (Araucaria); other masses resemble red cedar. There are indications that the wood had commenced to decay before it was silicified. Prof. Carter believes that the petrifaction took place in the sandstone and shale, and was due to

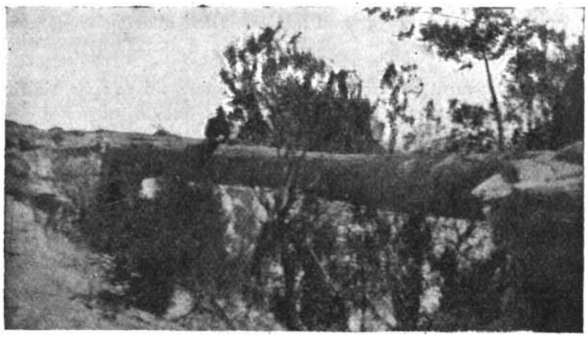

FIG. 1.—Agate bridge formed of petrified tree trunk, 111 feet long, spanning ravine in Arizona.

soluble silicates derived from decomposition of the felspathic cement in the sandstone.

THE delegates of the Clarendon Press have in preparation, and will shortly publish, an authorised translation of "Das Antlitz der Erde," by Prof. Eduard Suess. This English edition of a standard work will be prepared by Dr. Hertha Sollas under the supervision of Prof. W. J. Sollas, F.R.S., and will contain a preface written for it by Prof. Suess.

THE *Electrician* Printing and Publishing Co. announce the early publication of a work by Mr. F. Soddy entitled "Radio-activity: an Elementary Treatise from the Standpoint of the Disintegration Theory." The same company will issue in a few days a book by Prof. S. Lemström, entitled "Electricity Applied to Agriculture and Horticulture."

A NEW edition of an illustrated price list of chemical apparatus has been published by Messrs. Brewster, Smith and Co., of Cross Street, Finsbury Pavement, E.C. The new catalogue contains above four hundred more illustrations than the previous issue, and also full particulars of several new devices of which we have already given descriptions.

THE eighth volume of the new half-yearly series of the *Transactions* of the Leicester Literary and Philosophical Society has reached us. It is edited by Mr. O. T. Elliot. The volume contains the presidential address of Dr. R. Pratt dealing with the subject of "over-strain" and "nervous-breakdowns," which are traced to a wrong use of leisure; four papers read before the society; and the quarterly reports of six of the sections into which the association is divided. We notice that this Leicester society was founded in 1835, and has thus had nearly seventy years of useful work.

ON account of the ease with which gold can be obtained in the pure state, the exact determination of its melting point is an important datum for high temperature measurements. Previous observers have given values ranging from 1061° (Callendar, Heycock and Neville) to 1091° (Barus), the average of the more recent work being 1064° C. In the current number of the *Comptes rendus* a new determination of this constant is described by MM. A. Jacquerod and F. L. Perrot, in which direct comparison with the gas thermometer, with fused silica bulb, is adopted. The heating was carried out in an electrical resistance furnace of special type, giving a complete control over the temperature in the neighbourhood of 1000° C. Owing to the smallness of the coefficient of expansion of silica, the correction for the expansion of the bulb amounts to only 2°, as against 35° to 40° for the same instrument with a platinum bulb. The mean result with the nitrogen thermometer was 1067°·2 C., and the results obtained when the bulb was filled with other gases showed that the coefficients of expansion of oxygen and carbon monoxide are very close to that of nitrogen.

THE additions to the Zoological Society's Gardens during the past week include a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Mr. T. P. Eykyn; two Mountain Ka-Kas (*Nestor notabilis*) from New Zealand, presented by Mr. T. E. Doune; a White-tailed Ichneumon (*Herpestes albicauda*) from Africa, six White-crowned Pigeons (*Columba leucocephala*) from the West Indies, two Large-billed Weaver-birds (*Ploceus megarhynchus*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

COMET 1904 *a*.—Herr M. Ebell has calculated a new set of elements and an ephemeris for Brooks's comet, the former differing slightly from that published by Prof. Pickering. They have been derived from observations made on April 17, 20 and 24, and are given below:—

$$T = 1904\ \text{February}\ 28{\cdot}8792$$

$$\infty = 50^\circ\ 53'{\cdot}2$$
$$\Omega = 275\ 18{\cdot}5$$
$$i = 125\ 0{\cdot}0$$
$$\log q = 0{\cdot}42950$$

Ephemeris oh. M.T. Berlin.

1904	α h.	m.	s.	δ °	′	log Δ	Brightness
May 2 ...	16	6	56	+52	44·4	0·3556	0·95
6 ...	15	50	5	+54	23·1		
10 ...	15	32	16	+55	44·8	0·3672	0 88
14 ...	15	13	50	+56	47·2		
18 ...	14	55	15	+57	31·9	0·3831	0·81

(Kiel Centralstelle *Circular*, No. 66).

It will be seen from the above ephemeris that the comet is travelling along just inside the southern border of Draco towards Ursa Major, and is becoming fainter. On May 6 it will be very near to, and south of, a small triangle of stars which is situated about 4° south of θ Draconis.

DIMINUTION OF THE INTENSITY OF THE SOLAR RADIATION.—In a communication to the Paris Academy of Sciences M. Ladislas Gorczyński publishes two tables showing, in the first, the mean monthly values of the solar intensity and the absolute humidity, and in the second the maximum values of these two quantities for each month during the years 1901, 1902 and 1903. The tables give the differences between the values for the corresponding month of each year, and show that the diminution in the intensity, which M. Dufour stated (*Comptes rendus*, vol. cxxxvi. p. 713) commenced in December, 1902, really commenced at Warsaw in May of that year. Until more positive evidence as to the effect of the dust ejected from Mont Pelée on the observed solar intensity is forthcoming, M. Gorczyński hesitates to ascribe the diminution to this cause (*Comptes rendus*, No. 5).

THE PERIODICAL APPARITION OF THE MARTIAN CANALS.—In a paper read before the American Philosophical Society Mr. Percival Lowell discusses the 375 drawings of the Martian surface made by him during the opposition of 1903. Having plotted the values allotted to the "visibility" of eighty-five canals, at different periods, with regard to the time of their minima visibilities after the Martian summer solstice, he found that these minima appeared in regular sequence from the North Pole towards the equator. Mr. Lowell believes that the canals are strips of vegetation dependent for their growth—and therefore for their visibility—upon the simultaneous presence of sunlight and water, and he points out that on a planet, such as the earth, where water is constantly present all over the surface, the appearance of vegetation solely depends upon the amount of sunlight received; therefore in the northern hemisphere it simply progresses northward with the sun. On the other hand, he concludes, from his curves, that there is no constant supply of moisture on the surface of Mars, and, therefore, although the sun may have reached the summer solstice, it is not until the snowcap melts and looses the water supply that the vegetation appears. Further, his curves indicate that when loosed the water moves southward at a remarkably steady rate of 53 miles per day, and, as the figure of the planet is shown by its spheroidity to be in a state of fluid equilibrium, he contends that the water must of necessity be conveyed southwards by artificial means.

The curves discussed are reproduced on seventeen plates which accompany the paper in No. 174, vol. xlii., of the *Proceedings* of the society.